STUDY REGARDING THE IMPACT OF WASTE LANDFILLS ON SURFACE WATERS

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ABSTRACT
The waste management problem is an issue of global interest associated with high costs due to the degree of hazard that they have on the environmental factors and on human health. The present paper aims to evaluate the impact generated by non-ecological waste landfills on surface waters, compared with the impact of ecological hazardous waste landfills on surface waters. The study was possible due to the location of the two landfills, situated near the same watercourse. The water samples taken and analyzed show the extent of the impact of non-ecological waste landfills, compared with the impact generated by the ecological hazardous waste landfills on surface waters, located downstream from the household waste landfill. Therefore, the objective of this study is to emphases the impact brought upon the surface watercourses by waste landfills in the municipality of Cluj-Napoca.

Keywords: impact, water pollution, environmental factors, waste landfill.

INTRODUCTION

In modern society, almost every product ends its life cycle as waste, due to the development of synthetic materials difficult to recycle (ALE V, 2009). Waste represents an enormous loss of resouces, both materials and energy, therefore the environmental politics focus on the principle of minimising the waste production (OROS AND DRĂGHICI, 2002). Once generated, waste requires special attention and complex management in order to reduce the amount of waste to be deposited to the maximum (SINGH, DATTA AND NEMA, 2009). Landfilling can be called the last stage in the cycle of a waste, so it is regarded as the least friendly to the environment. Costs of storing wastes in conditions with minimum impact on the environment are significant. Ecological waste deposits represent a necessity in Romania. Compliance with the environmental standards required by the European legislation is in the process of implementation in Romania. Most of the waste landfills were built between 1970-1980 and the landfilling continues untill this day exceeding storage capacity. Legislative requirements of environmental factors protection at the moment of building the waste landfills did not require complex waterproofing composed of artificial barriers, leachate collection, capturing of landfill gases or other measures for environment protection present in the legislation today. The landfills included in the study conducted for Cluj-Napoca offer the possibility to observe the importance of legal framework. A household waste landfill like that is the Pata-Rat landfill, remembered in the 349/2005 law concerning waste landfilling. It is considered a non-compliance landfill which will cease/stop its activity between 2009-2017. The ecological hazardous waste landfill belonging to S.C Terapia S.A was built in 2006 as a result of including the old deposit of hazardous waste of the same company, in the 349/2005 law concerning waste landfilling, being considered an industrial hazardous landfill which will cease/stop its activity until 31.12.2006(MONITORUL OFICIAL AL ROMÂNIEI, 2005).

MATERIAL AND METODS

Location of the study area

The deposits included in study (Non-compliance municipal waste landfill Pata-Rat and ecological hazardous waste landfill of S.C Terapia S.A) are located in the Someseni region, Pata-Rat area, in the Eastern part of Cluj-Napoca city. The access to the above mentioned waste deposits can be made from the DJ105Scountry road, witch appears as Pata Rat street up to the municipal household landfill. In the vecinity of the household landfill there are the Zapodie river and theValcele-Apahida belt bypass in the East, Pata-Rat street in the North anda pasturade in the South and West. In the vecinity of the ecological hazardous deposit there are the Zapodie river and the Valcele-Apahida belt bypass in the East, a pasturade in the South and North, while to the West lies the DJ 105S country road, *Figure 1*.

Figure 1. Location of study area

(Source: INTERNET 1)

Area and landfills description

The topography of the area consists of high hills of 300-400 m, with sloping that descends from West to East down to the Zapodie river (INTERNET 2). Non-compliance municipal landfill has no channels to collect leachate and the slope of the terrain favors the leakage of the leachate into the Zapodie river, affluent of the Somes river. The Eastern side of the household waste landfill reaches up to approximately 15-20m from the Zapodie riverbed. The non-compliance municipal waste landfill occupies an area of 9 hectares with significant visual impact on the area (INTERNET 3).

The ecological hazardous waste landfill is located at 100-150m from the Zapodie river and has a waterproof structure base that complies with the regulations of the 349/2005 law and the 747/2004 technical normative. The waterproof structure consists of both artifficial ecological barriers (geomembranes and geotextiles) and natural (compacted clay). The leachate is collected and emptied so that the risk of polluting surface waters or groundwaters is avoided.

Sample prelevation and the equipment used

The water sample prelevation points from the Zapodie river are indicated in *Figure 2.*

Figure 2. Water sample prelevation points from the Zapodie river
(Source: INTERNET 1)

The water sample prelevation points were determined as follows:
P1 – Upstream from thePata-Rat municipal household waste landfill
P2 – Downstream from thePata-Rat municipal household waste landfill/Upstream from the ecological hazardous waste landfill of S.C. Terapia S.A.
P3 – Downstream from the ecological hazardous waste landfill of S.C Terapia S.A.

The water sampling was made throughtout the following months: March - April - May, in a number of 5 collection sessions, with a frequency of about 15 days. From a meteorological point of view it can be mentioned that the season when the water samples were collected (spring) is a season with important amounts of precipitations that can influence the results of the analyses. Thus, in this particular case, the concentrations of the pollutants can be reduced due to the high dillution attributable to rains. The water samples analysis was realised with the help of the WTW 720 Inolab analysis device, a stationary conductometer equipped with two electrodes, one for determining the pH and the redox potential eh (mV), and the other for determining the salinity (‰), temperature (˚C), electrical conductivity EC (µS/cm) and the total of dissolved solids TDS (mg/L).
The gases formed after the reaction process between the dissolved solids that are usually organic and the oxygen in the water give the water a bad smell and taste, preventing the oxygen from being absorbed in the water and so the auto cleaning. The suspensions deposit on different installations, warp the filters and they are toxic for the aquatic flora and fauna.

RESULTS

The results obtained are presented in the graphics from Figures 3-7. For the comparison of the results obtained experimentally with the normal values of the water, use the data presented in *Table 1.*

Table 1. Table of normal values of drinking water

Nr .crt.	pH	eh(mV)	t(°C)	EC(µS/cm)	TDS(mg/L)	Salinitate(‰)
1	6.5-8.5	-100 - 0	-	1000-1500	500-1000	0.2

(Source: MONITORUL OFICIAL AL ROMÂNIEI, 2004)

The analyses conducted show that the pH of the water, *Figure 3*, is situated between the values 7.5 and 8.5, so as the determined pH ranges in the domain of the pH values of the drinking water. The complexity of the substances in the leachate that flows in the Zapodie river stabilizes the level of the pH. *Figure 3* also shows an increase of the pH value from the prelevation point P1 (upstream from thePata-Rat non-compliant municipal waste landfill) to the prelevation point P2 (downstream from thePata-Rat non-compliant municipal waste landfill). The prelevation point P3 (downstream from the ecological hazardous landfill) has an insignificant increase of the pH level of the water.

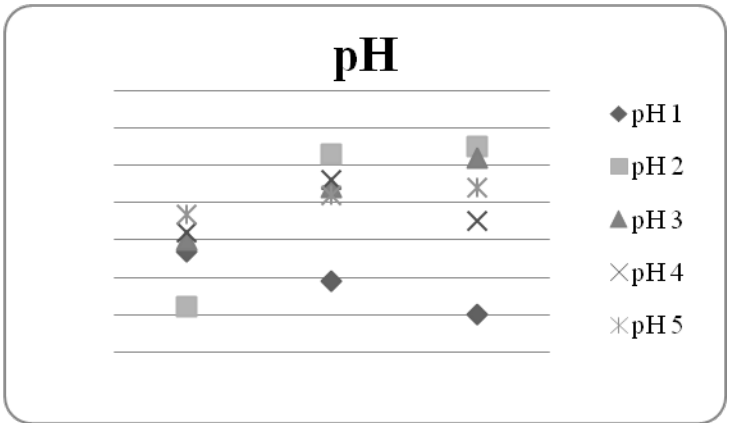

Figure 3. Representation of the pH level in the Zapodie river

According to the *Table 1*, the measured redox potential has normal values situated between -100 and 0 (mV). The water samples analyses show that eh(mV) situates between -35mV and -60mV, *figure 4*. Eh(mV) is strongly connected to the pH and water hardness. The corelation between eh(mV) and pH shows the domain of stability of minerals and chemical compounds. The differences between the results obtained are not major, but there was an increase from the prelevation point P1 to P2 which confirms the contribution of the Pata Rat non-compliance municipal waste landfill.

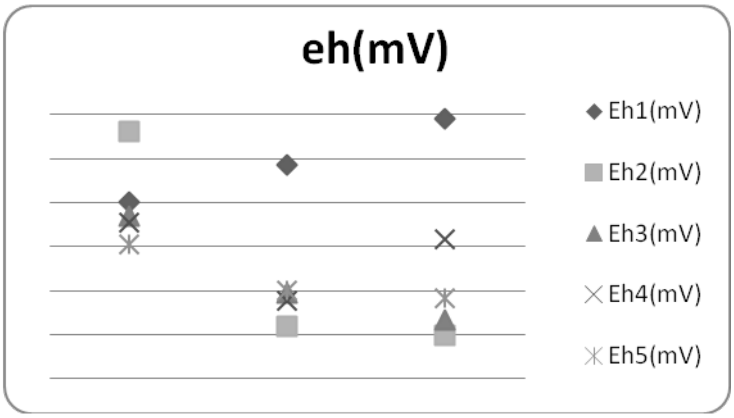

Figure 4. Representation of the redox potential in Zapodie river

Conductivity is strongly connected with water salinity and the bigger the salinity, the higher the electrical conductivity, with a direct proportionality between each other. *Figure 5*shows a significant increase from prelevation point P1 to P2 and stability from prelevation point P2 to P3 which leads to stressing the contribution of the Pata Rat non-compliance municipal waste landfill.

The water samples analised show an exceeding of the normal values of drinking water conductivity up to 4 times.

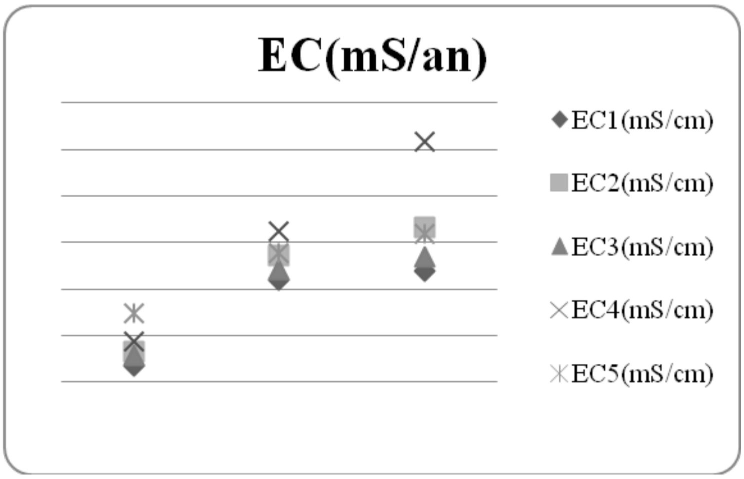

Figure 5. Representation of the electrical conductivity in Zapodie river

The measurements made for determining the total of dissolved solids from the samples taken upstream from the Pata Rat non-compliance municipal waste landfill indicates the TDS value of approximately 2200ml/L, *Figure 6*, which is a high value considering that the domain for TDS in drinking water is situated between 500-100ml/L. *Figure 6* also shows that in P2, the prelevation point located downstream from the Pata-Rat non-compliance municipal waste landfill, a value up to 2900ml/L was attained, exceeding the CMA values (maximum allowed concentrations) 3 times. This increase is determined by the contribution of the household waste landfill. In the prelevation point P3, the TDS values are stabilising and get close to the prelevation point P2 with one exception, TDS 4, with a value of 3550ml/L.

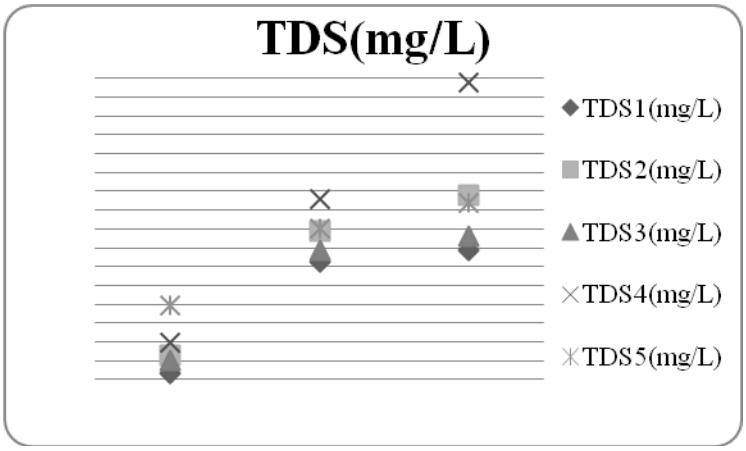

Figure 6. Representation of the total of solids dissolved in Zapodie river

The water salinity as shown in *Figure 7* gets to approximately 1.7‰ in prelevation point P1, a high concentration compared to the values of maximum allowed concentrations (MAC) of 0.2‰, exceeding the maximum allowed values 8.5 times. In prelevation point P2, downstream from Pata Rat non-ecological waste landfill, an increase of the salinity concentration up to 2.4‰ can be seen, exceeding the MAC values 12 times.

The prelevation point P3 located downstream from the ecological hazarous waste landfill, belonging to the Terapia factory, doesnot have a significant contribution to the salinity of the water. In this prelevation point, the values obtained donot exceed the values in prelevation point P2, except for the result of the analysed "Salinity 4" sample, that gets to a concentration of 3‰.

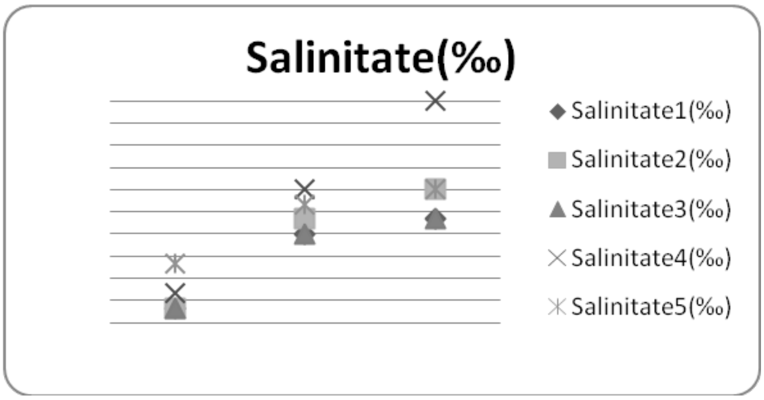

Figure 7. Representation of the salinity in Zapodie river

CONCLUSIONS

The conducted study concludes that the degree of pollution and the impact on the environmental factors caused by the Pata-Rat non-compliant municipal waste landfill in Cluj Napoca is significant. It is worth mentioning that there is a sinergical pollution, so that the area in which the landfills included in the study are located presents a high level of pollution on all the environment factors (water, air, soil). According to the obtained results, the differences between an ecological waste landfill and a non ecological one are significant.

It is therefore necessary an ecological rehabilitation and closing the non-compliance municipal waste landfill which represents the major source of pollution in the studied area.

ACKNOWLEDGEMENTS

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